Unmanned Aerial Systems at CNRM

The National Center for Meteorological Research (CNRM-GAME, Toulouse, France) has conducted UAS flights in Southern France on multiple UAS platforms (mini and mid-size UAS) to demonstrate their feasibility for meteorological and atmospheric studies.

UAS are especially adapted to:
- observe the atmospheric boundary layer processes at high spatial and temporal resolution,
- access to the vertical dimension and complement ground-based observatories,
- conduct measurements in hazardous or remote areas unreachable by manned aircraft (i.e., fog events, ocean studies, volcanic plumes).

First experiments – Avion Jaune Systèmes

- Mid-size UAS (4 m wingspan; payload < 5 kg; 8 hours)
- High aerosol concentrations in boundary layer; cloud layer at 900 m asl; second aerosol layer at 2300 m asl
- Profiles to 3000 m asl

BACCHUS

- UAS observations to evaluate aerosol-cloud closure studies
- Compare in situ measurements to remote sensing observations (lidar and satellite)
- Focus on contrasting environments: polar; tropics; mid-latitude
- CNRM: PhD students, two engineers + stagiaires

Planned parallel studies:
- ENV-MED: Cyprus (iCCN UAS, aerosol sampling; Apr 2015)
- DACCOVA: Benin, Africa (aerosol-clouds, ATR-42; June 2015)
- Neopro: Mediterranean Sea (clouds and aerosol, ATR-42; Jun-Jul 2015)
- (Impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic Understanding); Prof. Ulrike Lohmann, ETH Zürich)

VOLTIGE objectives:
- Demonstrate the use of multiple lightweight UAS to study the life cycle of fog.
- Encourage direct participation of students on the advancement and development of novel observing systems,
- Assess the feasibility of deploying UAS in Méteo-France's operational framework.

VOLTIGE

- Probe the atmosphere with multiple UAS
- PTU, solar flux, turbulence, cloud, and electric charge sensors
- Observation strategy with modular payloads based on science focus
- Master student, engineer, 8 stagiaires, 2 ENM courses, collaboration COST

UAS instrumentation

- Particle size & number (Dp > 0.3 μm, 555 g)
- Aerosol sampling (150 g)
- Cloud droplets (1.4 kg)
- Electrical field (<30 g)
- Temperature / humidity / airspeed (<20 g)
- Cloud base (190 g)
- Sun energy: visible (46 g)
- Turbulence (100 g)

- A number of instruments have been miniaturized for UAS payloads to measure aerosols, clouds, solar fluxes and meteorological parameters.
- A central data acquisition systems collects, time stamps, and stores the data for post-processing. A subset of the data is streamed to the ground control station.

UAS activities at CNRM

Research programs

Professional societies
- Institut de Recherche sur les Mini-Drones (GIS IRMID; RTRA-STAE): continuation of MAVRC
- International Society for Atmospheric Research using Remotely-piloted Aircraft (ISARRA): next conference in 2016 at University of Oklahoma (USA).

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